EXHIBIT #9

Group 3 – Google's Responsive Claim Construction Brief
(Civil Case Nos. 6:20-cv-00573-ADA, 6:20-cv-00575-ADA,
6:20-cv-00577-ADA, and 6:20-cv-00585-ADA)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

APPLICANT(s):	Kraft et al.	CONF. NO.:	3286
SERIAL NO.:	11/170,730	ART UNIT:	2617
FILING DATE:	29 June 2005	EXAMINER:	Gelin, Jean Alland
TITLE:	IMPROVED MOBILE COMMUNICATION TERMINAL, METHOD, AND COMPUTER PROGRAM PRODUCT		
ATTORNEY DOCKET NO.:	684-012299-US (PAR)		

Board of Patent Appeals and Interferences
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANT'S BRIEF

This is an appeal from the final rejection of the claims in the above-identified application.
A Notice of Appeal was electronically filed on 24 October 2008.

I.   REAL PARTY IN INTEREST

The real party in interest in this Appeal is Nokia Corporation, Espoo, Finland.

II.   RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences regarding this application.

III.   STATUS OF CLAIMS

Claims 1-25 are pending in the application.

Claims 1-25 have been finally rejected.

The claims on appeal are claims 1-25.

IV.   STATUS OF AMENDMENTS

There have been no amendments to the claims after the final rejection dated 24 June 2008.

V.   SUMMARY OF CLAIMED SUBJECT MATTER

Claim 1 recites a mobile communication apparatus (100) comprising a memory (108) configured to hold contact information (110) (Page 5, Lines 17-34), wherein items of said contact information (110) are stored in groups (200), each group having a respective tree structure comprising a plurality of logical levels (202, 203, 204, 205), wherein contact information (110) at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group (Page 1, Line 34 - Page 2, Line 14; Figs. 2-4).

2

Claim 9 recites A method for storing contact information in a mobile communication apparatus (100) comprising assigning a plurality of logical levels (202, 203, 204, 205) of a tree structure (Fig. 2) to respective groups (200) of said contact information (110), and storing contact information (110) in a logical level of said tree structure being related to said groups of contact information (Page 2, Line 33 – Page 3, Line 9), wherein contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group (Page 1, Line 34 - Page 2, Line 14; Figs. 2-4).

Claim 15 recites a method for accessing contact information in a mobile communication apparatus (100) comprising navigating to a logical level of a tree structure related to a respective group of said contact information (Page 3, Lines 10-18; Figs. 3-4), wherein contact information at a top logical level of the respective group includes contact information that is common to all lower level contact information belonging to the respective group, and accessing said contact information (Page 1, Line 34 - Page 2, Line 14; Figs. 2-4).

Claim 23 recites a user interface (106) comprising a display, and a processing unit (102) configured to present, on the display (Page 5, Lines 17-34), items regarding contact information (110) where the items are arranged in groups (200), each group having a tree structure comprising a plurality of logical levels (202, 203, 204, 205), wherein contact information (110) at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group (Page 1, Line 34 - Page 2, Line 14; Figs. 2-4).

VI.   GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1.   Whether claims 21 and 22 are patentable under 35 USC 112, first paragraph as failing to comply with the written description requirement.

3

2.   Whether claims 1-25 are patentable under 35 USC 102(e) over Nakano et al. (US 2005/0003870, hereinafter "Nakano").

VII. ARGUMENT

1.   Claims 21 and 22 are patentable under 35 USC 112, first paragraph. It is noted that the 112 rejection is based on the assertion that "[t]here was no disclosure that the computer program product is a computer readable medium having computer readable code means." While this statement remains contested by the Appellant, to expedite prosecution the Appellant previously amended claims 21 and 22 (in an amendment filed on 26 February 2008) to remove this language so claims 21 and 22 mirror the language in the specification. However, the Examiner has maintained the 112 rejection even though the subject language no longer exists in the claims. Therefore, the rejection under 35 USC 112 is baseless and should be withdrawn.

It is noted that MPEP 2163.02 states "[t]he courts have described the essential question to be addressed in a description requirement issue in a variety of ways. An objective standard for determining compliance with the written description requirement is, 'does the description clearly allow persons of ordinary skill in the art to recognize that he or she invented what is claimed.' *In re Gosteli*, 872 F.2d 1008, 1012, 10 USPQ2d 1614, 1618 (Fed. Cir. 1989)." Page 3 of Appellant's specification recites that "there is provided a computer program product directly loadable into a memory of a processor, where the computer program product comprises program code for performing the method according to the second aspect of the invention when executed by the processor." The language of claims 21 and 22 is virtually verbatim to the language in the specification, thus there can be no doubt that persons of ordinary skill in the art recognize that at the time the application was filed, Appellant had possession of the claimed invention.

Moreover, it is asserted that the claims as originally drafted satisfied the written description requirement. The Examiner appears to be asserting that "computer readable

4

medium" does not read on a "memory" and that "computer readable code means" does not read on "program code". It is noted that the term "computer readable medium" has an identical meaning in the art as the term "memory" and "computer readable code means" has an identical meaning in the art as the term "program code".

Thus, for the above reasons, claims 21 and 22 are patentable under 35 USC, first paragraph.

2.   Claims 1-25 are patentable under 35 U.S.C. 102(e) over Nakano. Claim 1 recites that items of the contact information are stored in groups, each group having a respective tree structure comprising a plurality of logical levels, wherein contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group. Nakano does not disclose or suggest this feature for the reasons described in Appellant's prior responses and for the additional reasons described below.

The Examiner supports the rejection, based on Figure 8 of Nakano, by stating "Fig. 8 is a screen page displayed on a portable information terminal, which is a tree structure of items of contact information in groups" (see page 2, lines 13-14 of the final office action dated 24 June 2008, emphasis added). This statement is unsupported by Nakano.

It is noted that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) and that "[t]he identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989). Nakano clearly does not expressly or inherently describe what is claimed by Appellant in as complete detail as is contained in Appellant's claims for the reasons described below.

5

Figure 8 of Nakano merely illustrates a "launcher screen" including a list of menu or selection items together with icons (Paragraph 0109) which when selected activate or launch an associated application program. These menu or selection items are clearly not a tree structure of items of <u>contact information in groups</u>. As noted by the Examiner the list of selection items includes mail, browser, address book, schedule, memo pad, file viewer, accessory and system setting. Aside from the address book the other categories of selection items clearly are not "contact information". For example, the browser selection item merely allows a user to browse content such as the Internet; the setting selection item merely allows a user to adjust settings (see Figs. 3-6); the mail selection item merely allows a user to view mail items that are presented in a list form (see Figs. 11-12); the file viewer selection item allows a user to view files in a list form (see Fig. 13). There is absolutely no disclosure in Nakano that "contact information is stored in groups," as claimed by Appellant, within the mail, browser, schedule, memo pad, file viewer, accessory and system setting selection items. Thus, the selection items in the "launcher screen" cannot be "contact information in groups" as asserted by the Examiner.

There is no disclosure in Nakano of any tree structure or that these selection items are represented in a "hierarchical" nature. It is again noted that it is well understood that a "tree structure" is a way of representing the "hierarchical" nature of a "structure" in a graphical form. (See Wikipedia definition, a copy of which is attached hereto in the Evidence Appendix as "Appendix A"). A tree structure will typically be shown as a graph in the shape of a tree. There is no such disclosure or representation in Nakano. Figure 8 of Nakano merely displays a number of "menu items (selection items)" (Paragraph 0109). The menu items are not ordered with "roots" or "nodes". Figure 8 is merely an assembly of menu items, with no particular ordering. Selecting one of these menu items, such as the mail item (55), opens another page which in this case is a page displaying a list of newly arrived mails (Paragraph 0141). Nakano does not disclose a tree structure as recited and defined by Appellant claims and specification.

6

The Examiner asserts that "a tree structure is not a storage device" but this statement has no bearing on the instant application.   Appellant's claims specify methods and apparatus for storing and accessing information in a structured manner where contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group. As an aid to understanding what is being claimed by Applicant, Figures 3 and 4 of Appellant's specification and their related text provide an understanding of storing and accessing information in the manner claimed by Appellant.   As a non-limiting example, with respect to Fig. 3 of Appellants specification, page 6, line 17 through page 7, line 11 recites,

> The top logical level item 300 can be associated with a company, here called C. The top item 300 can comprise contact information common for the entire company, such as switchboard telephone number, address to head office, web address, etc. This contact information can be comprised in sub-items (not shown) of the top item 300, or directly in the top item 300. Further, the top item 300 comprises links to items 302, 304 on a lower logical level, where the lower level items 302, 304 can be different sites of the company, here item 302 being associated with site A and item 304 being associated with site B. In this example, site A may comprise a factory and an administrative office, which each have an associated contact information item 306, 308 on a further lower logical level. Similarly, site B may comprise an R&D department associated with contact information in an item 310 and being logically linked to the item 304 of site B. Further, contact information about Ms. D, a contact person at site B, is associated with an item 312 which is linked to the item 304 of site B. Contact information about Mr. E, who belongs to the R&D department, but normally is situated at the office at site A, is associated with item 314, which is linked from the site A office item 308 and from R&D department item 310. Items 316, 318, 310, which are linked to contact information

7

item 314 about Mr. E can comprise e-mail address, home telephone number, mobile telephone number, etc. Further contact persons, e.g. Mr. J, can be associated with contact information items, e.g. item 322, linked to higher logical level items, e.g. R&D department item 310, and comprise contact information.

A similar example using family members instead of a company is given in Appellant's specification with respect to Figure 4 of Appellant's specification.

The Examiner further asserts that "each of the selection items includes logical levels". This statement is also unsupported by Nakano. As described above, Figures 3-6, 11-12 and 13 of Nakano respectively show the settings, mail items and files as nothing more than lists. Thus, each selection item shown in Figure 8 cannot have "logical levels" as recited in Appellant's claims. Despite "each of the selection items" not including logical levels, the Examiner specifically points to the address book as disclosing logical levels.

In the Examiner's example, when the address book selection item is selected from the launcher screen in Figure 8 of Nakano, the page shown in Figure 19 of Nakano is opened. As can be seen in Figure 19 of Nakano, an example screen page of group selection is shown where the groups include "all groups", a "work" group, a "co-worker" group, a "family group" and a "friend" group. When a group is selected from the tabs shown in Figure 19, the contact information is filtered depending on the selected group and each individual contact or address in the group is displayed on the terminal as can be seen in Figure 15 (paragraphs [0192]-[0193]). Detailed information that is linked to each address is displayed when an individual address is selected using the control switch part (paragraphs [0206]-[0218]).

The groups shown in Figure 19 of Nakano are merely filters pertaining to separate categories of entries that filter the address book contents to display only those entries belonging to a certain group. Again, Appellant's claim 1 recites that items of the contact information are stored in groups, each group having a respective tree structure

8

comprising a plurality of logical levels. There is no tree structure whatsoever associated with each of the group filters of Nakano. In Nakano, when the "all groups" category or filter is selected from the launcher page shown in Figure 19, every single entry in the address book is presented in a list form (i.e. the address list) as can be clearly seen in Figures 15, 16 and 18 of Nakano (Paragraphs 0206 and 0212).

There is no disclosure or suggestion in Nakano that the "all groups" filter has a "tree structure comprising a plurality of logical levels". Nor is there any disclosure or suggestion that the other filters (i.e. work, co-worker, family, friend) have tree structures as recited by Appellant. The lists in Figures 15, 16 and 18 of Nakano are nothing more than lists of entries arranged in a columnar form. A mere list cannot reasonably be considered as the equivalent to "a tree structure comprising a plurality of logical levels" as recited by Appellant. At best the "lists" shown and described with respect to Figures 15, 16 and 18 of Nakano can only be structured alphabetically or numerically (i.e. according to the 50-character kana syllabary) (See e.g. Paragraphs 0193-0194 of Nakano which describes tabs of the 50-character kana syllabary being used to select items from the displaying area 34 that are linked to a respective tab) and not as claimed by Appellant.

Further, Appellant's claim 1 recites that contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group. This is not disclosed or suggested in Nakano. The Examiner argues that the "friends group" is part of the "all group" and states "[t]herefore, [the] friend group has information that is common to [the] all group; friend includes names and addresses, and all group includes names and addresses." While it may be true that the contact information in the friends group is displayed in Nakano when the all group filter is selected, there is absolutely no disclosure whatsoever that the "contact information at a top logical level" of the all group "includes contact information that is common to all lower level contact information belonging to that group".

9

As can be seen in Figures 15, 16 and 18 (and the related description) of Nakano, there is absolutely no disclosure that the individual contacts in the list are related with each other and there is no indication of any order in which the address lists are presented other than that they are presented in 50-character kana syllabary (34). For example, referring to Figure 15, there is no disclosure in Nakano that the entry "OOOO" includes contact information that is common to all of the remaining entries. Rather as each entry is selected a screen pertaining only to the selected entry is displayed as shown in Figure 20. Thus, Nakano cannot and does not disclose that the "contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group". Nakano, merely displays each and every separate entry in the address book according to the 50-character kana syllabary (34).

Thus, claim 1 is patentable over Nakano because Nakano does not disclose or suggest that items of the contact information are stored in groups each having a respective tree structure comprising a plurality of logical levels, wherein contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group as recited by Appellant.

Claims 9, 15 and 23 are patentable over Nakano for reasons similar to those described above with respect to claim 1. Claims 2-8, 10-14, 16-22 and 24-25 are patentable at least by reason of their respective dependencies.

Further, claim 4 recites that the display view comprises all items of the tree structure. Nowhere is this disclosed in Nakano. The Examiner's statement "[d]isplaying a tree structure in a communication device is not patentable" appears to be directed to claim 4. However this statement is nothing more than a conclusory statement as the Examiner does not explain why it is not patentable. The Examiner is reminded that the Federal Circuit has stated that "rejections on obviousness cannot be sustained with mere conclusory statements; instead, there must be some articulated reasoning with some

rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006). See also *KSR,* 82 USPQ2d at 1396 (quoting Federal Circuit statement with approval).

The Examiner asserts that Figures 19 and 20 "illustrate a tree wherein selection of one item from the tree can be made, and any item selected at the bottom is associated with the item at the top" (see Page 5, lines 18-21 of the final office action dated 24 June 2008).   It is submitted that this statement is also not supported by Nakano.   As described above, all address entries on Nakano are presented in a list form not a tree structure as can be seen in Figures 15, 16 and 18.   In addition, Figure 8 of Nakano merely illustrates a menu screen for selecting a particular application of the terminal. When an item is selected from the menu of Figure 8 an operating screen page concerning the menu item is displayed (paragraph 0115).   Figure 19 and 20 of Nakano merely show additional menu items that are displayed in separate screens where the menu items are displayed after an item on a previous screen has been selected (See e.g. paragraphs 0045-0047).   Thus, because different screens are needed to display all the menu items in Nakano, Nakano cannot disclose or suggest that the display view comprises all items of the tree structure as recited in Appellant's claim 4.

Again, it is noted that "[a] claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) and that "[t]he identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).   All that is disclosed in Nakano with respect to Figures 19 and 20 is that "Fig. 19 is a schematic drawing showing one example, of a screen page of group selection displayed on a portable information terminal shown in Fig. 1" (Paragraph [0094]) and "Fig. 20 is a schematic drawings showing one example of a screen page of personal information displayed on a portable information terminal shown in Fig. 1" (Paragraph [0095]).   One cannot reasonably view this language as expressly or inherently describing what is claimed by Appellant in as
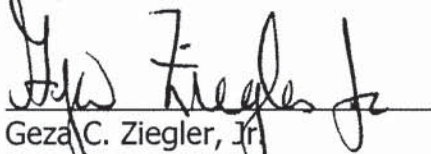
11

complete detail as is contained in Appellant's claims. There is simply no support in Nakano for any of the Examiner's arguments relating to Nakano disclosing a display view comprising all items of the tree structure.

Therefore, claim 4 is patentable for this additional reason. This argument applies equally to claims 11 and 17.

It is also submitted that claims 23-25 are patentable over Nakano for reasons similar to those described above.

A check in the amount of $500 is enclosed herewith for the appeal brief fee. The Commissioner is hereby authorized to charge payment for any fees associated with this communication or credit any over payment to Deposit Account No. 16-1350.

Respectfully submitted,

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12

VIII. CLAIMS APPENDIX

1.   A mobile communication apparatus comprising a memory configured to hold contact information, wherein items of said contact information are stored in groups, each group having a respective tree structure comprising a plurality of logical levels, wherein contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group.

2.   The mobile communication apparatus according to claim 1, wherein said logical levels are defined by links between at least a higher level item and at least a lower level item.

3.   The mobile communication apparatus according to claim 1, wherein said contact information is configured to be presented according to said tree structure on a display of said mobile communication apparatus.

4.   The mobile communication apparatus according to claim 3, wherein a display view comprises all items of said tree structure.

5.   The mobile communication apparatus according to claim 4, wherein said display view comprises a scrolling function to be able to view a user selected part of said items.

6.   The mobile communication apparatus according to claim 3, wherein said tree structure is configured to be presented with relations between items together with images, texts, or symbols, or any combination thereof, related to said items, respectively, and said presented tree structure is browsable by a user.

7.   The mobile communication apparatus according to claim 3, wherein a group of lower level items linked to an item of a higher logical level are presented together with said higher logical level item.

13

8.   The mobile communication apparatus according to claim 1, wherein said contact information comprises home telephone number, work telephone number, mobile telephone number, private e-mail address, work e-mail address, home address, work address, image, text, symbol, sound, red-letter day, or web address, or any combination thereof.

9.   A method for storing contact information in a mobile communication apparatus comprising:

> assigning a plurality of logical levels of a tree structure to respective groups of said contact information; and

> storing contact information in a logical level of said tree structure being related to said groups of contact information,

> wherein contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group.

10.   The method according to claim 9, further comprising presenting said contact information according to said tree structure on a display of said mobile communication apparatus.

11.   The method according to claim 10, wherein a display view comprises all items of said tree structure.

12.   The method according to claim 11, further comprising scrolling said display view to view a user selected part of said items.

13.   The method according to claim 9, wherein said contact information comprises home telephone number, work telephone number, mobile telephone number, private e-mail address, work e-mail address, home address, work address, image, text, symbol, sound, red-letter day, or web address, or any combination thereof.

14

14.   The method according to claim 9, wherein said logical levels are associated to groups, families, companies, departments, teams, clubs, or personal relations, or any combination thereof.

15.   A method for accessing contact information in a mobile communication apparatus comprising:

navigating to a logical level of a tree structure related to a respective group of said contact information, wherein contact information at a top logical level of the respective group includes contact information that is common to all lower level contact information belonging to the respective group; and

accessing said contact information.

16.   The method according to claim 15, further comprising presenting said contact information according to said tree structure on a display of said mobile communication apparatus.

17.   The method according to claim 16, wherein a display view comprises all items of said tree structure.

18.   The method according to claim 17, further comprising scrolling said display view to view a user selected part of said items.

19.   The method according to claim 15, wherein said contact information comprises home telephone number, work telephone number, mobile telephone number, private e-mail address, work e-mail address, home address, work address, image, text, symbol, sound, red-letter day, or web address, or any combination thereof.

20.   The method according to claim 15, wherein said logical levels are associated to groups, families, companies, departments, teams, clubs, or personal relations, or any combination thereof.

21.   A computer program product stored in a memory comprising:

15

computer readable program code for causing a computer to perform the method as defined in claim 9.

22.   A computer program product stored in a memory comprising:

computer readable program code for causing a computer to perform the method as defined in claim 15.

23.   A user interface comprising:

a display; and

a processing unit configured to present, on the display, items regarding contact information where the items are arranged in groups, each group having a tree structure comprising a plurality of logical levels, wherein contact information at a top logical level of a respective group includes contact information that is common to all lower level contact information belonging to the respective group.

24.   The user interface of claim 23, wherein the processing unit is further configured to present all items of the tree structure on the display.

25.   The user interface of claim 23, further comprising at least one scroll bar where the processing unit is further configured to present a portion of the tree structure on the display, the scroll bar being configured to allow horizontal and/or vertical scrolling of the tree structure on the display.

16

IX.   EVIDENCE APPENDIX

Appendix   A   -   Wikipedia   definition   of   "Tree   Structure"   from
http://en.wikipedia.org/w/index.php?title=Treestructure&printable=yes

17

APPENDIX A

18

Tree structure

From Wikipedia, the free encyclopedia

A **tree structure** is a way of representing the hierarchical nature of a structure in a graphical form. It is named a "tree structure" because the graph looks a bit like a tree, even though the tree is generally shown upside down compared with a real tree; that is to say with the root at the top and the leaves at the bottom.

In graph theory, a tree is a connected acyclic graph (or sometimes, a connected directed acyclic graph in which every vertex has indegree 0 or 1). An acyclic graph which is not necessarily connected is sometimes called a forest (because it consists of trees).

A tree structure showing the possible hierarchical organization of an encyclopedia. This specific example happens to be a complete binary tree, which means all nodes have exactly zero or two child nodes.
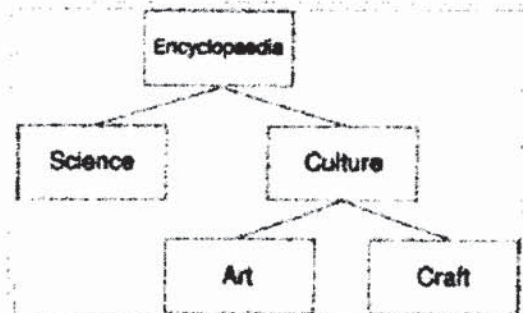
Contents

- 1 Nomenclature and properties
- 2 Examples of tree structures
- 3 Representing trees
- 4 See also
- 5 External links
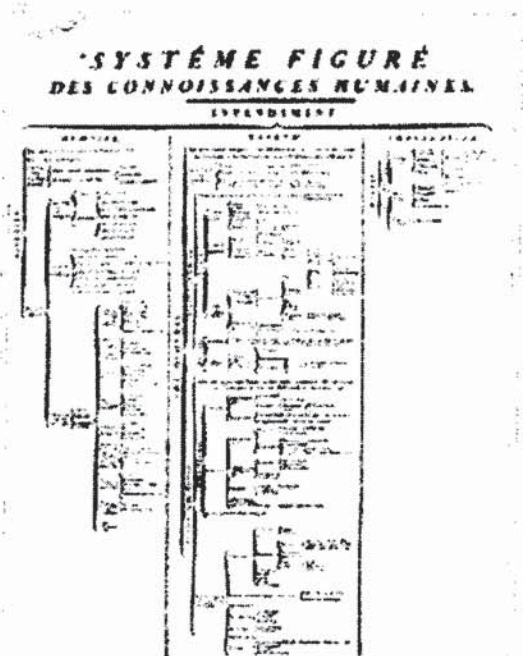- 6 References

Nomenclature and properties

Every finite tree structure has a member that has no superior. This member is called the "root" or root node. It can be thought of as the starting node The converse is not true: infinite tree structures need not have a root node.

The lines connecting elements are called "branches", the elements themselves are called "nodes". Nodes without children are called "end-nodes" or "leaves".

The original Encyclopédie actually used a tree diagram to show which way its subjects were ordered.

The names of relationships between nodes are modeled after family relations. In computer science, traditionally only names for male family members had been used. In linguistics, the names of female family members are used. It is said that this was an express countermovement to the traditional naming convention, started by the female students of linguist Noam Chomsky. However, nowadays, in computer science at least, the gender-neutral names

19

"parent" and "child" have largely displaced the older "father" and "son" terminology, although the term "uncle" is still used for other nodes at the same level as the parent.

- A node is a "parent" of another node if it is one step higher in the hierarchy and closer to the root node.
- "Sibling" ("brother" or "sister") nodes share the same parent node.
- A node that is connected to all lower-level nodes is called an "ancestor".

In the example, "encyclopedia" is the parent of "science" and "culture", its children. "Art" and "craft" are siblings, and children of "culture".

Tree structures are used to depict all kinds of taxonomic knowledge, such as family trees, the evolutionary tree, the grammatical structure of a language (the famous example being S → NP VP, meaning a sentence is a noun phrase and a verb phrase), the way web pages are logically ordered in a web site, et cetera.

In a tree structure there is one and only one path from any point to any other point.

Tree structures are used extensively in computer science (*see* Tree (data structure) and telecommunications.)

Examples of tree structures

- Internet: usenet hierarchy, Document Object Model's logical structure[1], Yahoo! subject index, Open Directory Project
- Information management: Dewey Decimal System
- Management: hierarchical organizational structures
- Computer Science: binary search tree Red-Black Tree AVL tree
- Biology: evolutionary tree
- Business: pyramid selling scheme
- Project management: work breakdown structure

Representing trees

There are many ways of visually representing tree structures. Almost always, these boil down to variations, or combinations, of a few basic styles:

- Classical node-link diagrams, that connect nodes together with line segments:

```
encyclopedia
   /        \
science    culture
            /    \
          art    craft
```

- Nested sets that use enclosure/containment to show parenthood (for an interesting variation on this, see Treemaps (http://www.cs.umd.edu/hcil/treemap-history/)):

20

```
+--------encyclopedia-------+
|           +--culture--+   |
| science  |art   craft|   |
|           +-----------+   |
+---------------------------+
```

- Layered "icicle" diagrams that use alignment/adjacency:

```
+-----------------------+
|    encyclopedia       |
+-----------------------+
| science | culture |
+-----------------------+
         |art|craft|
         +---+-----+
```

- Diagrams that use indentation, sometimes called "outlines" or "tree views":

```
encyclopedia
   science
   culture
      art
      craft
```

- Nested parentheses, a correspondence first noticed by Sir Arthur Cayley

```
((science, (art,craft)culture)encyclopedia
```

Identification of some of these basic styles can be found in:

- Jacques Bertin, Sémiologie graphique, 1967, Éditions Gauthier-Villars, Paris (2nd edition 1973, English translation 1983);
- Donald E. Knuth, The Art of Computer Programming, Volume I: Fundamental Algorithms, 1968, Addison-Wesley, pp. 309-310;
- Brian Johnson and Ben Shneiderman, Tree-maps: A space-filling approach to the visualization of hierarchical information structures, in Proceedings of IEEE Visualization (VIS), 1991, pp. 284-291;
- Peter Eades, Tao Lin, and Xuemin Lin, Two Tree Drawing Conventions, International Journal of Computational Geometry and Applications, 1993, volume 3, number 2, pp. 133-153.

See also

Kinds of trees

- B-tree
- Dancing trees
- Tree (data structure)
- Tree (graph theory)
- Tree (set theory)
- Tree (descriptive set theory)

Related articles

- Data drilling
- Hierarchy

External links

- Visualization of phylogenetic trees on the T-REX server (http://www.trex.uqam.ca/)
- Using a tree structure to design a business process (http://www.stcwdc.org/PDF/newsletter_may05.pdf) - from the Society for Technical Communication

References

1. ^ What is the Document Object Model? (http://www.w3.org/TR/DOM-Level-2-Core/introduction.html) (html). *W3C Architecture domain*. Retrieved on 2006-12-05.

Retrieved from "http://en.wikipedia.org/wiki/Tree_structure"

Categories: All articles with unsourced statements | Articles with unsourced statements since February 2007 | Trees (structure)

X.   RELATED PROCEEDINGS APPENDIX

Not Applicable.